

TRIPLE LEFT-TURN LANES AT SIGNALIZED INTERSECTIONS

PROBLEM STATEMENT

The use of triple left turns is frequently considered to accommodate constantly increasing traffic demand at signalized intersections. Although triple left turns have been in use for a number of years and their operational benefits are documented, they are still considered a relatively new design alternative that many agencies are reluctant to approve. While some excellent guidelines appear in the literature, there are no universal standards that apply.

At the initiation of this project, the State of Florida had a total of 12 known intersections installed with triple left turns. Most of these were located in Dade and Broward Counties. Over the course of this project, five new triple left turns have been added, while an existing triple left turn was converted to a double left turn to make room for another traffic movement at the intersection.



A typical triple left turn site

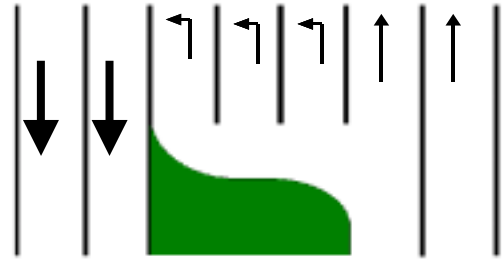
OBJECTIVES

The objectives of this project were to investigate the current usage of triple left turns from an operational, safety, and modeling perspective and to develop guidelines for triple left-turn installations based on these findings. The project tasks included:

- Review of existing studies of operations and safety, as well as guidelines used by other states for double and triple left turns.
- Conduct of operational analyses to determine the capacity parameters of multiple left turn lanes.
- Modeling of triple left turn lane operations with available intersection and arterial performance analysis software products.
- Assessment of the safety performance of triple left turns, identifying crash patterns with associated intersection features and comparing the safety performance of triple and double left turn lane configurations
- Development of recommended criteria for adding turn lanes and/or new construction that includes triple left turn lanes.

FINDINGS AND CONCLUSIONS

Most of the literature on multiple left turn lanes is concerned with double left turns. The most definitive work on triple left turns was developed by Akeret (1994), who conducted a study of triple left-turn intersections for the Nevada Department of Transportation. Based on triple left turns in Las Vegas, Nevada, Akeret formulated general criteria for the geometric design of triple left-turn lanes at signalized intersections. He identified three general types of triple left-turn lane configurations that have been gaining acceptance for its design and construction. The three configurations shown at the right are extensions of those used for double left turns:

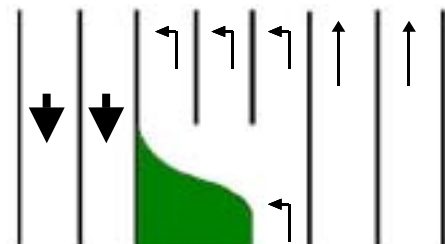


Type A: Three exclusive left turn bays

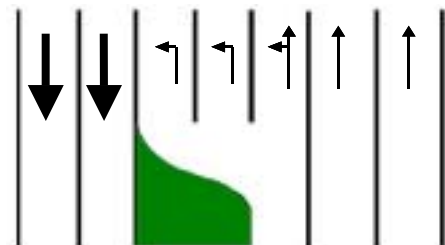
- Type A: Three exclusive left turn bays
- Type B: Two exclusive left turn bays plus an exclusive left turn trap lane
- Type C: Two exclusive left turn bays plus an optional through-left lane

Akeret considered the following conditions to be inappropriate for triple left-turn lane installations:

- When there is a potential for a higher number of pedestrian-vehicle conflicts.
- Left-turning vehicles are not anticipated to queue uniformly within the provided left-turn storage due to downstream conditions.
- Conditions exist that obscure, or result in, confusing pavement markings within the intersection.
- Right-of-way restrictions prohibit adequate design-vehicle turning maneuver space within the intersection.
- The installation is not economically justified when compared with other alternatives to improve intersection capacity.



Type B: Two exclusive left turn bays plus an exclusive left turn trap lane



Type C: Two exclusive left turn bays plus an optional through-left lane

When researchers examined the operational and safety characteristics of several intersections, in Florida, with both double and triple left turn lanes, the results suggested that the third lane for a triple left-turn lane configuration increases the capacity of the intersection by approximately one-third. Existing literature suggests that the improvement would be somewhat less than a full one-third increase in the number of vehicles serviced for each traffic signal cycle. Empirically, the only way to establish the magnitude of the increase would be to obtain before and after data for a variety of configurations that are upgraded. Because the number of such projects is expected to

be limited in the near future, uniform data would have to be drawn from across the nation, rather than from Florida alone.

According to the literature, observed increases in crash rates at intersections with triple left-turn lanes can usually be attributed to the complexity of the intersection or to deficiencies in the design itself. A reasonable conclusion is that triple left-turn lanes do not have a significant adverse effect on safety at intersections that are both simple and properly designed. However, they may accentuate problems at complex intersections and those with design deficiencies.

The crash data in this study is limited but does suggest that for certain simple configurations, such as Y junctions, triple left-turn lanes have no adverse influence on safety. For locations with more complex intersections (e.g., roads with medians, closely spaced adjacent intersection, 4-leg intersections), there is a hint that triple left-turn lanes may reduce safety. Again, without direct “before-after” comparisons for upgraded intersections or analyses using rigid control of geometric and traffic characteristics, there is no empirical way to establish the impact that triple left turn lanes will make on safety.

The value of traffic models in analyzing triple left-turn operations is well recognized, especially when any complications are present from upstream or downstream intersections. An investigation of the most common software products that model signalized intersection operations suggested that none of the models recognizes the unique characteristics of triple left turns explicitly. Instead, they all represent triple left turns as three-lane movements that happen to be turning left. There is little or no difference between three-lane through movements and triple left turns. Nevertheless, the existing models are able to represent the most important aspects of triple left turn configurations, as long as the mechanics of the turn itself (e.g., large trucks turning simultaneously) are not an issue. The effort involved to incorporate empirically calibrated triple left turn logic into any of the existing models would be difficult to justify.

BENEFITS

This project has resulted in a host of recommendations for updating design criteria needed to effectively implement triple left-turn lanes. By facilitating their use, the research promotes the benefits that accrue from triple left-turn lanes, including the ability to handle large volumes of traffic, reduce conflicts between left-turn and driveway vehicles, and reduce driveway spillback—that is, the potential to improve safety and reduce congestion. Gaps in knowledge addressing safety and operational factors governing design criteria for the installation of triple left-turn lanes have been filled with this research.

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